"FORESTS OF THE DRIER AREAS OF WESTERN AUSTRALIA."

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Western Australia, which occupies almost one-third of the Continent, is in the main a land of low rainfall. Of its total area of 976,000 square miles, only one-eighth (12.6%) receives an annual rainfall of 20 inches or better. Even of this the larger portion (9%) lies within the tropics and carries practically no forest of economic value.

The table hereunder shows approximate areas (in 1,000 square mile units) falling within the various rainfall zones, together with corresponding percentage of the State's total area represented by each:—

	Over 40in.	40in.—30in.	30in.—20in.	20in.—15in.	15in.—10in.	10in.—8in.	Under 8in.
A.	4·9 ·5%	21·5 2·2%	61·5 6·3%	29·3 3·0%	125·9 12·9%	... ...	... ...
B.	9·75 1·0%	9·75 1·0%	15·6 1·6%	26·3 2·7%	97·6 10·0%	325·0* 33·3%	249·0† 25·5%

Total area of State—976,000 square miles.

A Within tropical rainfal belt—summer rainfall system.

B Extra tropical—winter rainfall system.

* Part within A and part within B—rainfall irregular.

† Rainfall irregular. This area forms a buffer between tropical and extra tropical systems.

The better known commercial forests of Jarrah, Karri and associated species are confined to that small fraction (2% of total area) of the State which receives 30 inches of rainfall or better per annum, with Wandoo extending eastward as open forest to areas of 20 inch rainfall.

Beyond the 20-inch isohyet, which lies some 50 miles east of Perth, occurs the inland forest or sclerophyllous woodland.

Although the timber trees of these forests are little known beyond the boundaries of the localities where they grow, they represent a valuable asset and have played a considerable part in the State's development—particularly in respect of the mining industry.

Tropical Zone.

The tropical portion of Western Australia is of very minor importance in timber production, and with the exception of the small, isolated and difficult accessible belts of native pine (Callitris intratropica) which are found in the extreme north of the State, the few species which attain the dimensions and quality of even low grade mill logs are confined to the banks and beds of the rivers. The vivid green of the foliage of these riverine species contrasts sharply with the duller hues of the xeraphytic vegetation a few yards away, beyond the influence of the river moisture.

The more common species found in these river belts are:—

River Gum—Euc. camaldulensis.
Blackheart—Euc. microtheca
Cadjuput—Melaleuca leucadendron.
Leichhardt Pine—Sarcocephalus cordatus.
Chestnut—Terminalia platyphylla.
Figs—Ficus spp.

The limited quantity of these timbers available, coupled with the attenuated pattern of their distribution, quite apart from their poor form and inherent faultiness renders their use in anything but a very small way, impracticable.

Small quantities are sawn, for station use, usually on rough benches driven by low power petrol engines. However, on the less developed stations more primitive methods are used and the outfit may be no more elaborate than a couple of station hands with a blunt crosscut saw.

Low forests of stunted Eucalypts with a grassy ground flora are found in portions of the Kimberley Division. These are Western Australia's only true savannahs. They carry no trees of timber value.

Extra Tropical Zone.

From about the 20-inch to the 9-inch isohyet, in belts of varying extent, distributed through an area of some 120 million acres, occurs the sclerophyllous Eucalypt woodland. These belts are interspersed with non-timber country, viz., cleared areas, salt lakes (and treeless country near them), Mallee, scrub plains and heath.

In view of the great area involved, the inaccessibility of much of it and the lack of detailed assessments, any estimate of its total area must of necessity be an approximation. However, what data is available indicates an area of some 18 million acres, of which approximately one-third has been cut over.

In spite of the comparatively meagre rainfall, some fine trees occur; in fact, trees which must be considered unique in the floras of the arid regions of the world.

This Eucalypt zone can be broadly divided into three, viz.:—

(a) 20-inch to 15-inch Rainfall.—The York Gum (E. foecunda, var. loxophleba), Jam (Ac. acuminata), association with, of course, other species, e.g., the Mallets, Manna Gum (Acacia microbotrya), etc., in minor proportions, although not necessarily of minor importance. The area of this forest has been considerably reduced by clearing for agriculture.

(b) 15-inch to 11-inch Rainfall.—The Salmon Gum, Gimlet, Morrel and Yorrell associations which have also been largely removed in the development of what is now the main wheat growing area of the State.

(c) 11-inch to 9-inch Rainfall.—The eastern portion of the zone, beyond the generally recognised agricultural belt, where no clearing for agriculture has been carried out. The timbers include those in (b), together with a number of additional species, e.g., Euc. Dundasi, Euc. Brockwayi, Euc. Le Soueffi, Euc. Woodwardi, etc. In this subzone in no month does the average precipitation exceed the evaporation. The soil types of the zone fall into four broad groups, viz.:—

(1) The red brown loams with considerable calcium carbonate in the subsoil and in some instances, particularly in the south-easterly portion of the zone, coming right to the surface. These soils carry the main timber trees of sub-zones (b) and (c) above.

It is interesting that at a depth of 6-10 feet an acid subsoil occurs. The presence of the alkaline layer above this has been attributed by some workers to the action of the forest flora, drawing calcium from the lower layers and returning it by the deposition and subsequent decomposition of debris, to the surface of the ground whence it is transported back to the soil as carbonate. The light nature of the precipitation—an average of about 20 points per wet day is not conducive to the transport of this material to any great depth.

(2) The brown and grey sandy and loamy surfaced soils, alkaline but less so than (1). These carry mainly Mallee. (Nos. (1) and (2) above correspond to the "Mallee" soils (of Prescott) of the Eastern States.)

(3) The brown and red brown medium textured soils more or less neutral in reaction, with dark clay subsoils. These occur in the western portion of the zone, i.e., sub-zone (a) where the action of slightly heavier rainfall has resulted in the calcium being replaced by iron and aluminium.

(4) The yellow and grey sandy and gravelly soils—in some areas showing areas of massive laterite—acid in reaction and carrying heath or scrub such as Wodjil (Acacia Beauverdeana, Ac. signata, etc.), Tamma (Casuarina campestris) and some small Mallees (Euc. leptopoda, etc.). These soils represent portions of a very ancient land surface formed under climatic conditions involving heavier rainfall than at present.

On the edges of the scrub plain belts where the laterite has weathered away exposing the less durable underlying rock, small cliffs or breakaways occur. Amongst the weathered material of these breakaways some important species are found, notably the Mallets (Euc. astringens, Euc. Gardneri and Euc. falcata) and Wandoo (Euc. redunca).

Since the heavier and richer soils of the wheat belt carried the timber species, it is not surprising that enormous quantities were destroyed in the process of clearing. This has proved a great handicap to these concerns throughout the area requiring wood fuel (e.g., alunite industry, flour mills, pumping stations, etc.).

The "forests" of the 11-inch to 9-inch rainfall zone have been of considerable importance in that they have supplied the bulk of the fuel and mining timber for several of the main goldfields of the State. Prior to the construction of the railway line to Kalgoorlie, sawn Salmon Gum was used for building purposes. However, when rail transport enabled sawn Jarrah to be placed on the market at about one-quarter the price, its use for this purpose ceased. The toughness of the inland timbers makes them invaluable for mining purposes where great strength and resistance to abrasion are required and while most of the mining timber is used in the round, a steady demand exists for sawn Salmon Gum and Morrel for underground use.

Since the discovery of gold, some 27 million tons of timber has been cut from the inland forests for use as fuel and mining timber.

This has entailed the felling of some 7 million acres of forest. At one time the consumption was in the region of a million tons per year, but it is now about a quarter of that figure. Firewood for the Golden Mile (Kalgoorlie) is at present transported slightly over a hundred miles from the forest on a private (3-ft. 6-inch gauge) railway. The greatest distance hauled to date was about 130 miles. Within 150 miles of Kalgoorlie are ample supplies of timber for at least another half century.

In view of the low value per acre of these forests and the uncertainty of the life of the mining industry, no special steps, such as the planned retention of seed trees or vigorous growing stock, are taken to ensure regeneration or the provision of timber for subsequent cutting. By far the greater proportion of cutover country, however (estimated at 90 per cent.), carries some second growth, seed for the production of which has been provided by the felled crop and by large over-mature trees which have been left by the cutters.

In some parts the regeneration has been prolific; in others sparse, the success depending on a number of factors, viz., the species, the site, the locality, the seasons, the occurrence or absence of fires through the tops after the cutting. Second growth timber is protected from general cutting.

The problem which causes so much concern to the majority of Australian foresters, the uncontrolled fire, is of minor importance in the inland Eucalypt forests.

Bush fires are infrequent and except following clear felling operations or after occasional wet seasons when a heavy growth of grass and ephemeral herbage develops, they are of very small extent. All trees of the interior are extremely fire tender and only the Mallees coppice after a fire. A light fire with flames only a couple of feet high is sufficient to cause the death of thin barked species, such as Gimlet (Euc. salubris).

To the east the Eucalypt belt becomes broken and the trees sparse with Mallee types predominating and eventually it merges into the Nullarbor Plain.

To the north there is a somewhat gradual transition from an Eucalypt to an Acacia association. In this transition region are found extensive areas of "Oak" or "Belah" (Casuarina lepidophloia).

In this Acacia association the commonest species is Mulga (Acacia aneura). Mulga is found over extensive areas of inland Australia and the virtual extermination of this species over considerable areas in the Eastern States has been a matter of grave concern to pastoralists and soil conservationists.

It would appear that under the severe and irregular conditions under which Mulga exists, death from drought, at times on a wholesale scale over many acres, has been a common feature, while grass fires following wet seasons (e.g., 1942) have devastated considerable areas.

In the past the durability of the seed of Mulga and the species associated with it has ensured a replacement in better seasons. With the new set of factors introduced with our entry into the country, the natural sequences have been upset. Grazing animals, both native and introduced, destroy not only many of the young plants, but also

seed. There is evidence that Mulga in this State in its young stages is not relished by stock, but whether this is the case in extreme droughts may be doubted. There is a field here for much further research.

The demand made by the mining industry for fuel and timber have been particularly heavy for many miles round many of the mining towns and even in recent years some 20,000 tons of it has been used per annum on the northern goldfields.

While it is undesirable that a plant with the browsing value of Mulga should be felled for fuel, the economic importance of the mining industry is a factor which cannot be ignored. The greater part of the Mulga used is required for producer units which cannot easily change to other fuel.

To reconcile as far as may fairly be done the conflicting interest of the pastoral and mining industries, certain restrictions have been imposed in connection with the cutting of Mulga. The most important of these are:—

(1) A minimum diameter limit of three inches is imposed for all cutting.

(2) No cutting of green Mulga is permitted on any area not carrying more than seven trees per square chain and on any area cutover at least seven trees over four feet in height must be left per square chain.

(3) The cutting of green Mulga for domestic firewood is prohibited, while industrial plants are required to use a high proportion of dead Mulga as fuel.

While Eucalyptus camaldulensis occurs along the larger water courses throughout the Mulga zone, perhaps the most interesting Eucalypt of this region is the Desert Gum (Euc. eudesmioides). This occurs both in Mallee and tree form and specimens 40 feet or more in height are not uncommon. It is invariably associated with Spinifex (Triodium spp.) on red sands and is found in areas of very low rainfall some two hundred miles north-east of Kalgoorlie. Its timber is brittle and of little value except for firewood, but the drought resistance of this tree should render it worthy of consideration in wind eroded inland areas.

Sandalwood, Santalum spicatum, a small tree of insignificant appearance which has been exported to Asiatic countries for years, has provided the well-known aromatic wood of commerce and also a valuable essential oil.

Originally occuring to within sixty miles of Perth, it is now rare within the agricultural areas. During recent years practically the whole of the supplies have been obtained well to the east of the agricultural areas, even as far afield as 140 miles east of Laverton.

This species is a root parasite and the density of stocking is limited by the ability of the normal vegetation to support it, hence it does not occur in anything but very scattered formation.

Attempts to regenerate it have been frustrated by the introduced rabbit and this tree must ultimately approach extinction.

The Santalum lanceolatum of the northern portion of the State has been used to some extent for oil distillation, but remaining supplies are limited and inaccessible. The oil content of the wood varies considerably in trees from different sites and different localities. While all supplies which reach the market came from northern ports, odd specimens of this tree are found to within 100 miles of Kalgoorlie. These southern trees are almost entirely lacking in oil and are of no economic importance.

Arboricultural.—The raising of dry area species for use by farmers for planting on over cleared farm land has become a function of the Forests Department. Considerable difficulty had always been experienced in raising dry area species in the coastal nursery, so a nursery for these was established at Kalgoorlie. Over 40 species of Eucalypts have been raised, of which about a dozen show promise of being suitable for extensive use.

In the appendix are listed the more important inland species with their major characteristics and requirements set out in tabular form.

In order to test various species under field conditions a number of arboreta were established throughout the wheat belt during 1949. Particular attention is directed to the finding of suitable species for the lighter lands which were originally treeless and to date the most promising for such lands appear to be Euc. camaldulensis, Euc. Woodwardi and, of course, Euc. cladocalyx.

Residents of the eastern agricultural areas are becoming conscious of the need for shade and shelter trees for their various soil types, and it is our aim to supply what they require.

PRINCIPAL TREES OF INLAND W.A.

Species.	Common Name.	Soil Type in which found.	Locality (Habitat).	Average Annual Rainfall.	Purposes for which used.	Special Features, etc.
uc. astringens ...	Brown Mallet ...	Lateritic loamy soils and sandy to medium loams	Narrogin, Wagin, etc. ...	16in.—20in.	Tan bark—timber for tool handles	Ornamental as well as useful tree.
Euc. brachycorys ...	Ribbon Gum ...	Loamy sands in Lake country ...	East of Southern Cross and Norseman District	11in.	Small mining timber, firewood, etc.	Should be useful tree for sand drift country.
**Euc. Brockwayi* ...	Dundas Mahogany ...	Basic rocky hills and also on sandy loams on flats near hills	Norseman District ...	11in.	Mining timber and firewood ; locally for tool handles	A fast growing, ornamental tree producing a tough, useful timber.
Euc. camaldulensis ...	River Gum	Along water courses from Leonora northwards	In all mainland States ...	8in. upwards	In W.A. mainly as fuel and mining timber. Only used where nothing else available	A fast growing tree adaptable as to soils and useful for wheat belt planting.
Euc. campospe ...	Silver Gimlet ...	On red loams of from light to heavy texture	Eastern Goldfields, etc.	8in.—10in.	Firewood. Usually hollow and unsuitable for timber	A very drought-resistant tree. Suitable for shade.
**Euc. Dundasi* ...	Dundas Blackbutt ...	On loams of various textures. Prefers soils with alkaline reaction	Norseman District and also Mulline	9in.—11in.	Mining timber and firewood ...	About the best of W.A. trees for street planting in inland towns.
Euc. eudesmioides ...	Desert Gum ...	On loamy sands ; in spinifex country	Laverton District ...	8in.	Suitable for firewood but too scattered and inaccessible to be extensively used	Possibly suitable for planting on sand drift country in inland areas.
Euc. falcata	Silver Mallet ...	Lateritic loamy soils and on sandy to medium loams	Narrogin District, Ravensthorpe, etc.	15in.—20in.	Tan bark but inferior to *euc. astringens*	A substitute for *euc. astringens*, to which it is generally inferior.
**Euc. flocktoniae* ...	Merrit	Sandy to medium loams ...	Eastern wheatbelt, Eastern Goldfields, Norseman, etc.	9in.—12in.	Small mining timber, tool handles (locally), firewood	Produces good poles and is quite an ornamental tree.
Euc. foecunda, var. loxophleba	York Gum	Sandy to medium loams ...	Northampton, Northam, etc.	12in.—19in.	Wheelwrights' work	Tree is generally of poor form and untidy appearance.
Euc. gracilis	Yorrel	Sandy to heavy loams near lakes	Southern Cross District, etc.	11in.—12in.	Firewood	Makes a very good shade tree. Fairly salt tolerant.
Euc. Gardneri ...	Blue Mallet ...	Lateritic loamy soils and on sandy to medium loams	East of Great Southern Railway	15in.—19in.	Tan bark but inferior to *euc. astringens*	A substitute for *euc. astringens*, to which it is inferior.
Euc. Le Souefii ...	Goldfields Blackbutt	Laterite ridges and on loams of various textures	Eastern Goldfields, Norseman, etc.	8in.—11in.	Firewood and small mining timber	A drought-resistant tree adaptable as to soils. Not in any way spectacular.
†*Euc. longicornis* ...	Morrel	Sandy loam overlying layer of limestone nodules	Great Southern and Wheat Belt	11in.—18in.	Mining timber, firewood, tool handles, etc.	A tree growing to large dimensions in its natural state.
Euc. occidentalis ...	Flat-topped Yate ...	Sand over clay in poorly drained situations	Near Great Southern Railway and eastward to Esperance and Salmon Gums	12in.—24in.	Firewood	Suitable for planting in low-lying areas.
Euc. redunca (var. elata)	White Gum or Wandoo	Laterite soils and loams on and near breakaways	Generally through the Wheat Belt	11in.—35in.	Inland forms only, firewood and fence posts. In heavier rainfall areas, milling, "Myrtan," etc.	Suitable for the more acid soils of the inland areas.

* Trees suitable for use in the round as mining timber.

† Trees used for milling for mining timber.

PRINCIPAL TREES OF INLAND W.A.—*continued.*

Species.	Common Name.	Soil Type in which found.	Locality (Habitat).	Average Annual Rainfall.	Purpose for which used.	Special Features, etc.
†*Euc. salmonophloia* ...	Salmon Gum ...	Sandy loams to heavy clay loams	Wheat Belt to Goldfields and beyond	8in.—18in.	Mining timber both sawn and in round, firewood, etc.	The largest and best of the inland trees. Requires a good soil. Early growth slow.
**Euc. salubris* ...	Gimlet	Medium to heavy loams ...	Wheat Belt and Goldfields	8in.—16in.	Mining timber and firewood ...	Produces a tough timber but seldom attains large size. At its best on the heavier soils.
Euc. Sargentii ...	Salt River Gum ...	Low lying sandy loams near lakes	East of Cunderdin, etc.	14in.—16in.	No particular use	Suitable for low lying areas near salt lakes. Subject to attack by borers.
Euc. Stricklandi ...	Yellow flowered Blackbutt	On poor laterite hills and on loams near hills	East and south of Kalgoorlie	9in.—11in.	Firewood only	An ornamental tree suitable for inland planting.
Euc. torquata ...	Coral flowered Gum, Coolgardie Gum	On rocky hills, usually basic soil	Coolgardie and Norseman, etc.	9in.—11in.	Firewood	A popular ornamental and shade tree.
**Euc. transcontinentalis*	Boongul	On sandy loams to medium loams	Eastern Wheat Belt, Eastern Goldfields, Trans. Line. etc.	9in.—12in.	Firewood, mining timber, and locally for tool handles	A tree of very variable habit of growth. A substitute for Salmon Gum on lighter soils.
Euc. Woodwardi ...	Lemon flowered Gum	Deep loamy sands	About 100 miles east of Kalgoorlie	8in.—9in.	Not used on account of remoteness from industrial areas	A drought-resistant tree suitable for light soils. Popular on account of its striking yellow blossoms.

* Trees suitable for use in the round as mining timber. † Trees used for milling for mining timber.